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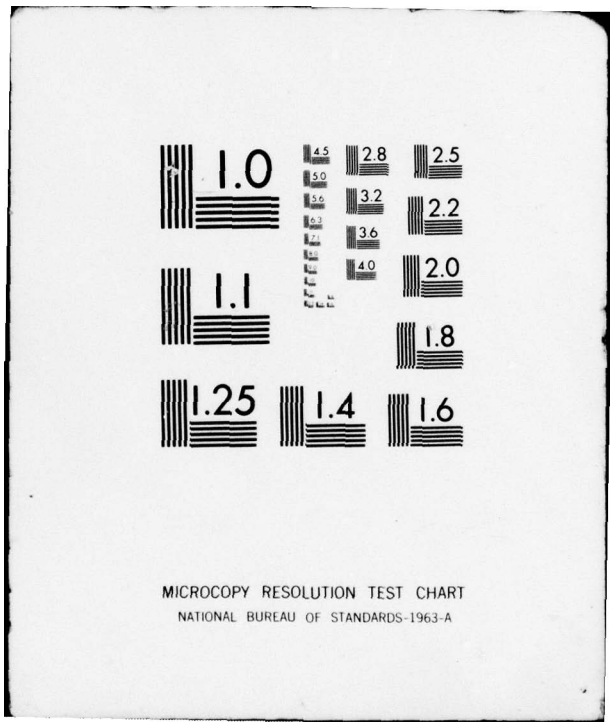
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AERONAUTICAL KNOWLEDGE
(SELECTED ARTICLES)

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EDITED TRANSLATION

FTD-ID(RS)T-2168-77 20 January 1978

MICROFICHE NR: FTD-78-C-000197

AERONAUTICAL KNOWLEDGE (SELECTED ARTICLES)

English pages: 16

Source: Hang K'ung Chih Shih, No. 3, 1977, pp. 22-23; 26; 34-35.

Country of origin: China
Translated by: LINGUISTIC SYSTEMS, INC.
F33657-76-D-0389
H. P. Lee
Requester: FTD/WE
Approved for public release; distribution unlimited.

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Table of Contents

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Weather and The Safty of Flight

--- Random notes on a civil air trip ---

Ch'i Fan

In the morning, it was cloudy and the sky was densely covered by dark clouds. According to my plan, today I should complete the next part of my journey, but,due to this kind of weather, I began to doubt about the possibility that the plane could take off. My heart became so heavy as if it were covered by clouds, too. However, I arrived at the air port at the time as planned. It was about one hour from the scheduled time of departure, and I randomly came to the information desk in the waiting room. There a young lady with two braids hanging on her back was writing something on the bulletin board. I went forward and saw on the board the time of arrival and departure of planes from and to various routes. There was also a notice indicating that some plane would take off on time and some would have to delay. I then curiously asked the young lady why on the same route within a short interval of time, some plane could take off on time and some could not. With a smile she said that it was because the weather standards of the pilots were not the same. As she realized that I could not completely understand her answer, she then began patiently to explain to me what the weather standard meant. According to the degree of their proficiency and flying experience, pilots of different types of planes have different weather standards. If the weather condition is lower than the regulated standard of a pilot, he would not be allowed to fly.

"Isn't there any pilot of'all-weather'?" I asked as I suddenly remembered

that I had seen such a term in a magazine.

"This term cannot be applied to civil aviation." She continued her explanation, "In fact, the so-called 'all-weather' is but a relative term. As the nature changes so immensely, often some natural phenomenon directly affects the completion of a flight. As a transportation enterprise in a socialistic society, the first concern of China's civil aviation is that we must carry out our responsibility in transportation under the condition of safty."

"After all, what kind of natural phenomena will affect flight?" Her explanation was interrupted by a person who stood by her. The other travelers, who were waiting for their planes, heard such an interesting question, all came over. Recognized the interest of the crowd, the young lady began enthusiastically to talk about the relationship of weather and flight.

Effects of Weather to the Safty of Flight

The effects of weather to the safty of flight can be generally classified into three categories: First, the weather phenomena that harass pilot's vision are such as low clouds, heavy rain, fog, dust and others. All these can jeopardize the safty of a plane at the time of taking off and landing.

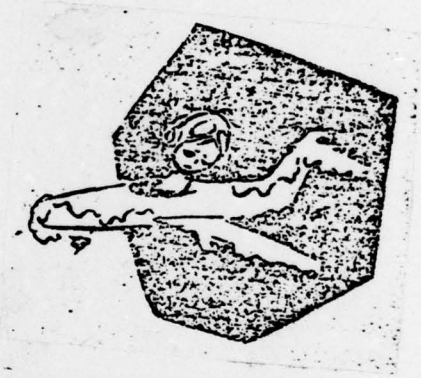
Picture 1 Weather phenonmena that affect pilot's vision

Second, natural forces that can directly damage the plane or its controlling rudder make the control of flight very difficult. Sometimes because it is beyond the ability of a pilot to control or because the

structure of the plane is not strong enough to resist the natural force, a very serious consequence happens. These natural forces are such as storm, violent shaking caused by turbulent air and strong wind in air field.

Picture 2 Effects of natural forces to the structure of a plane

Third, ice formation in the air can lead to change the streamlined appearance of a plane and destroy its aerodynamic property.

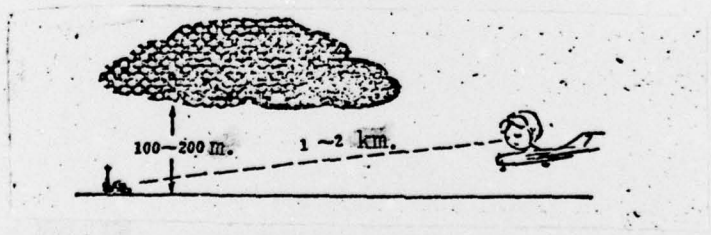


Picture 3 The streamlined appearance of the plane has changed due to the ice formation

Obstruction of Pilot's Vision

As a result of the advancement of science and technology, the aviation supporting equipment has gradually become complete. On most of the large air fields today, there are various kinds of navigation, flying and landing supporting equipment. Among them is one called "blind landing". It would be wrong if the term is taken literally as means that a pilot with the help of this equipment can land a plane with his eyes closed. On the contrary, all the way of a flight, there are wireless installations and navigation equipment to help the pilot, so even under the condition that the target on

the ground is completely invisible, he can still safely and acurately reach the air port of his destination. Especially in landing, before the plane touches ground, the pilot must use his eyes to survey the ground condition so as to decide how to make the plane touch the ground. If the pilot's vision is obstructed at this moment, the landing will be very difficult and it may result in a disaster. According to statistics, more than 90% of accidents in international air transportation occurred at the time of taking off or landing, and the landing accidents are more than those of taking off. In order to quarantee safty in taking off and landing of a plane, each air field, according to its different equipment and ground conditions, decides different weather standards for pilots who have different degrees of training and experience, and regulates minimum cloud altitude and visibility when a pilot is trying to take off or to land. Generally, there are No.1 and No.2 two different weather standards, and the regulated cloud altitude is 100-200m and visibility is 1-2km. Today, at the air port of various

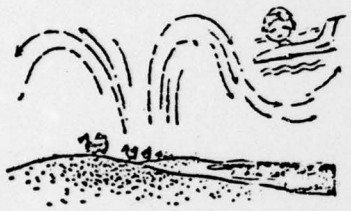


Picture 4 Required visibility for landing

countries, where the air field is well equipped, the minimum requirement for No.1 weather standard is that cloud altitude is 30m and visibility 300m. To comply with this standard, it is required that the plane must be equipped adequately and the pilot must have expertly skill and adequate experience.

Phenomena of Outside Forces Working Against a Plane

Any one who has experience of flying in a plane knows that a plane in flight sometimes shakes violently and the shaking makes people in the plane feel unconformtable. Especially flying over a desert in the summer, because of the heat of the sand, the temperature in the air that is close to the earth becomes very high. As the hot air impetuously goes up, there forms a strong convection current. The air stream high above thereby becomes unstable. When a plane confronts such kind of air stream, it begins to shake.



Picture 5 Plane shaking over a desert area

There is another situation, when a plane enters into dense cloud or rain cloud or flies in an area where a storm is very active, the plane too shakes violently. As each plane has a designed strength limitation, in addition to making people in the plane fell distressing, the shaking can damage the structure of a plane when the strength of shaking is stronger than the designed strength limitation of the plane and ,the plane may even be wrecked completely. So when a pilot sees the possibility of having strong shaking, he usually tries to change his altitude to avoid the possible shaking.

Picture 6 Changing altitude to avoid violent shaking

On the ground, wind always takes effect on the taking off and landing of a plane. Each air field therefore, for meeting its weather standard, has regulations with regard to wind direction and wind speed. Planes of a certain type will not be allowed to take off or to land when the wind direction

and wind speed cannot meet the requirement of weather standard. The reason for this is that it will be very difficult to control a plane and the plane may be seriously damaged when the strength of the wind against its rudder is too strong and the strength of the control equipment is not strong enough to resist the wind.

Destruction of the Streamlined Appearance of a Plane

Even in the hot summer, a plane flying high above in the air can sometimes be attached with ice on its body. This is because the temperature in the atmosphere comes from the earth as the sun radiates its heat on the earth. So the temperature in the air becomes lower gruadually as the altitude increases. Generally speaking, within a range of altitude, which a plane can reach, the temperature decreases 0.65°C by every 100m of increase of altitude. So in the summer when the temperature on ground is about 30°C, in the air of 5,000-6,000m (high) above, the temperature will be well below zero. While a plane is flying in this cold air, its outside body will naturally becomes cold. When it enters into cloud or an area where it is raining, ice can certainly be formed on the part of its body, which is facing wind. The major hazard of ice to a plane is to change its streamlined appearance and to destroy its aerodynamic property. As a result, the head resistance is increased and the plane becomes heavier, and consequently it cannot maintain its altitude and speed. Sometimes, if the motor air-inlet tube and the heat dissipator bear ice, the motor stops working, and sometimes the ice falls into the air-inlet tube on the motor and breaks the blades of the high velocity revolving compressor in the motor. Any one of these can produce a serious consequence. Today, most of the large cargo planes are equipped

with ice-preventing devices. When the condition of ice-forming comes, the devices are turned on and the part of the plane where there is a possibility of forming ice is heated up. Thus no ice can be formed and the thin ice which has been there can be melt away. In order to avoid having ice on the body of his plane, a pilot usually changes his route to keep away from cloud and rain.

Picture 7 Changing route to avoid rain

Finally, the young lady said with every confidence, "Although the immense changes of nature can bring some unfavorable effects to the flight, but none of these natural phenomena cannot be overcome. As a result of the advancement of aviation science and meteorology in China, the supply of weather information through the hard work of the department of aviation meteorological service is adequate. Safty in our aviation is always responsibly quaranteed."

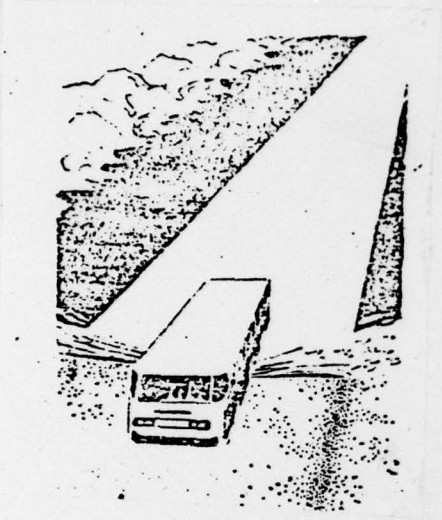
While she was talking, another service person in the waiting room using a marrophone urges passagers to get on board of their plane. The plane I am going to take will take off on time. The worry I had about weather this morning now proves unnecessary.

On the field, a silvery white plane is ready to take off and the service people on the plane enthusiastically help passagers in one way or the other. A few minutes later, a pleasant air trip of mine will begin.

(Pictures by Li Chia)

An Airfield Snow-sweeping Vehicle

An Airman



During the cold winter, people customarily think of the scenery in northern China -- the scene of snow.

Snowing and snow is but a natural phenomenon in winter and there seems to be nothing strange. But to the flight of an airplane, snow is indeed of effect.

As everyone knows that a plane after having touched ground in landing has to glide a certain distance on the runway before it can completely stop. During the gliding, in addition to its brake system, the plane has to make use of the friction of its wheels on the surface of the runway to resist the gliding and to shorten the distance of gliding. After snowing, the runway is usually covered by snow. As a result, the friction between the wheels of a plane and the surface of runway becomes lesser, and the plane therefore must glide a longer distance even if its brake system functions perfectly. But the length of a runway in an airfield has its limit and it cannot be increased freely at a time when an uncontrolled gliding of a plane on snow requires. It can certainly result in a disaster if a plane after having touched ground in landing cannot stop at a limited distance and rush off the runway. It can happen to a fighter, a bomber and a jet passager plane as well. Obviously, situation like this will jeopardize the safty of flight and the training for war, and it may

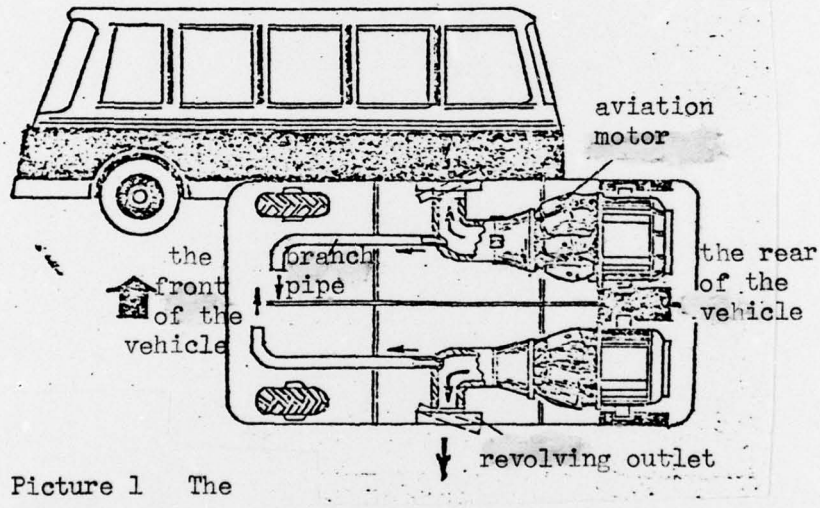
even lead to a loss of life and a defeat in war.

In order to avoid the happening of this kind and to quarantee the safety of flight, each time after snowing, many people, both civilian and military, are called up to sweep the snow by using simple and primitive tools, such as shovel and spade. The efficiency of their work and the backwardness of their tools cannot but catch our attention. In recent years, personnel of both air and ground service have hoped that China can earlier become able to use machines to sweep snow. But under the influence of the counter-revolutionary revisionism of Liu Shao-chih and Lin Pao, people's wisdom cannot be developed and ability cannot be applied. What can be done is to go along the foreign model at a snail's pace. In the past few years, the efficiency of using the so-called advanced snow plower they made is slower than manual work. In the end, all the plowers become but a pile of scrape.

Since Chairman Mao launched the Proletarian Cultural Revolution and destroyed the headquarters of the capitalist representatives Liu Shao-chih and Lin Pao, people's productive energy has been releases and production in both industry and agriculture has been greatly increased. Under such a favorable condition, cadres, soldiers and workers in the air force jointly criticize the revisionism of Liu and Lin and learn from experience of workers in other units. In only one year of hard work, we have successfully manufactured a modern automatic jet snow-sweeping vehicle, and ended the history of sweeping snow by manual labor in China.

The vehicle is made by using an airplane jet motor as power. It can go forward and backward and it is a vehicle for the special purpose of

sweeping snow. When the vehicle works, from the nozzle on the motor comes high speed combustion airstream. This airstream first gives a pressure to the snow that makes the snow separate from gound and then blows the snow away. Furthermore, the snow which is about two to three meters away from the nozzle can also be blown away by the diffused combustion airstream. Based on these principles, the snow on both sides of the vehicle can be blown as far away as 40-50 meters. In order to let the front wheels of the vehicle not stand on snow and be able to blow the snow underneath the vehicle away, at the turning point of the main nozzle on the motor a branch pipe is connected. This branch pipe is of a diameter of 120mm. and it reaches to the front wheels of the vehicle and it can blow the snow there away (see Picture 1)



Picture 1 The appearance of an airfield snow-sweeping vehicle

Right above: The arrangement of the motor and the exhaust nozzle

For the purpose of making the jet motor able to pull the vehicle forward and backward when it works, at the opening of the nozzle there is a revolving outlet, which can lead to change the direction of the flowing of the high speed combustion airstream. The revolving of the outlet is made by the air-liquid pressure system on the vehicle. The range of the

revolving angle is determined by the amount of snow and the speed of the motor. Picture 2 illustrates the principles of the vehicle going forward, stopping and backward.

A. When the combustion airstream coming out of the motor is perpendicular to 0-0, the central line of the vehicle, and the thrust of the motor is also perpendicular to the central line of the vehicle. So the vehicle is in the state of stopping.

B. When the combustion airstream changes its direction because of the revolving outlet, and the new direction forms an angle a with the vertical line A-A on 0-0, the central line of the vehicle, the thrust R can be divided into N and F. When F is greater than the friction of its tire and the ground, the vehicle will go forward. At this time, the speed of the vehicle is determined by angle a and the speed of the motor.

* Aviation science and technology in foreign countries *

Using Man-made Satellite to Predict Earthquake

Kuo Fang-ching

Earthquake is a natural phenomenon and it can be predicted by using effective means to observe its premonitory indications. Today, using man-made satellite to predict earthquake is still at explorative stage. It can only obtain some background materials of earthquake predicting, and these materials are helpful in making middle and long period forecast but they cannot foretell the imminence and arrival of earthquake. This article, based on the materials collected from a few foreign countries, attempts to make a brief introduction of the practice of using man-made satellite to predict earthquake.

In recent years, the practice of using man-made satellite to predict earthquake has gradually caught people's attention. In some countries, they have been engaging in some explorative work, and their efforts can be summed up and classified into two categories:

First, they use man-made satellite to make macroscopic survey and take pictures of the earth, and study the configuration and its macroscopic characteristics of the earth. By so doing, regions where earthquake can take place may possibly be mapped out.

Earthquake is a natural phenomenon and its occurence is related to the geological structure of the earth and the distribution of the faults. From the air, it will be easier to observe the geological and topographical features of the earth and the distribution of the faults. So the aviation

technicians are expected to be able to suggest some new and convenient ways in earthquake prediction.

A man-made satellite flying along an orbit several hundred kilometers high above is able to survey over a larger part of the earth and can also repeatedly take pictures of the earth. Certainly a picture of larger range can reflect the geological structure and topographical features better than that of a small range.

In the 1960's, the United States, for both political and military purposes, took a great number of pictures of the earth from man-made satellite and other flying vehicles. Through careful study it has been found out that those pictures not only have military value but they are also significant in some aspect of national economy, and they can help predict earthquake as well. The pictures of California taken from Apollo 7 and 9, for instance, indicate that there are three active and intersecting faults in the vicinity of Los Angeles. At a conference of astronomists in 1969, an announcement that there would be an earthquake in the region of Los Angeles was made. In February, 1971, there was really a large magnitude of earthquake which happened in that region. In order to understand the natural resources of other countries, in 1970, the United States made a plan to launch earth resources survey satellites. The main purpose of the plan is to study the geological structure and topographical features of the earth and to understand the distribution of the faults so as to work out a useful way of earthquake predicting.

Through research and experiment for a period of two years, on July 23, 1972, the United States launched its first earth resources survey satellite. The weight of the satellite is 892kg., the closest point of its orbit to the

earth is 905km. and the farthest point is 918km.. It takes 103.2 minutes to circle the earth once, and the inclination of its orbit is 99.125°. The satellite carries three multiple-spectrum cameras and four multiple-spectrum scanning devices. Ten days after entering orbit, the multiple-spectrum cameras stopped working because some difficulty had developed in the electricity route, but the multiple-spectrum scanning devices took pictures of various locations on the earth. From those pictures, the distribution of faults in certain areas can also be clearly seen. Through study of these pictures combining with analysis of historical materials, some new faults and the activities of the faults have been discovered. In Alaska, there occurred seven earthquakes, but there are only five faults in the geological map and only two of the quakes can be explained by these faults. Later, through analysis of the pictures taken by the satellite, seven more faults were discovered, and the other five quakes thereby have their explanations. In 1972, after the occurence of the serious earthquake in Managua of Nicaragua, the intersecting faults in that region can also be found in the pictures taken by the satellite.

Second, satellite technology combining with other devices of precise observation can be used constantly to watch the disturbance of the rotation axis of the earth and the transformation of the active faults.

It has been discovered through survey and study that earthquake is related to the disturbance of the rotation axis of the earth. Through a comparison of the dates of the disturbance of the rotation axis of the earth with the dates of 22 violent earthquakes from 1957 through 1968, it has been found out that 15 quakes have points of correspondence with the

disturbance of the rotation axis of the earth, and they constitute 68% of the total number of quakes during that period. Moreover, among those quakes, there were 6 most violent ones. From 1 to 18 days before the occurence of those violent quakes, there occurred 5 disturbances of the rotation axis of the earth, and from 5 to 18 days before the occurence of other 7 relatively strong quakes, there were 3 of those disturbances. Based on these facts, it is evident that the disturbance of the rotation axis of the earth is the premonitory indication of strong earthquake. So once such premonitory indication and the transformation of the active faults are recorded through precise observation, it can be sure that earthquake will take place in that region. This is the way of earthquake prediction. The reliability of such analysis, of course, has to have further confirmation.

Over the past more than ten years, the United States has launched a number of earth survey satellites and the main function of those satellites is to make survey of the targets of strategic weapon. The accuracy of the survey is about one meter. Due to the fact that the speed of the movement of the crust of the earth in many regions is very small, it never goes beyond 5mm. per year, so the accuracy of the earth survey satellite has been so far not able to meet the requirement for earthquake prediction.

On May 4 last year, the United States launched one sphere-shaped laser earth survey satellite, and this satellite is exclusively used to make high precision survey of the minute transformation of the crust of the earth and to watch the unusual changes of the rotation axis of the earth as well as the activity of local faults. Through such an effort, accurate forecast of earthquake may become possible. The structure of this satellite is rather

simple. It is made of two aluminum half-spheres bound together on a copper core. On the surface of the sphere, there are 426 laser reflecting mirrors. Due to the fact that the diameter of this satellite is small (60cm.), its weight is 410kg. and the altitude of its orbit is 5,900km., its movement in the space is stable. The satellite begins to make survey as soon as the ground station emits laser beam to it, and the optical laser reflecting mirrors on the satellite reflects laser pulse to the ground station. Thus during the time of reflecting back and forth, the ground station can find out the actual movement of the part of the earth, on which the station is located. The satellite can find out the movement of the local faults and the disturbance of the rotation axis of the earth. It has been said that the total survey task of this satellite cannot be completed until 1985. Based on the mathematic model of the movement of the crust of the earth as has so far been learned, it is not impossible to make an earthquake map of the whole earth, and in the next two decades, it is also possible to make forecast of some earthquake partially. The key technique of such a survey is that the satellite must have a stable orbit and the survey must be accurate.

On June 2, 1975, France launched a small laser earth survey satellite called "Lesser Star". Its weight is 74kg., and its diameter is 24cm.. It carries 60 laser reflecting mirrors. The principle of this satellite and its goal to be achieved are same as the one launched by the United States.

In short, the practice of using man-made satellite to predict earthquake in foreign countries is still at explorative stage. However, what has been achieved is very helpful in making middle and long period forecast of earthquake, but it cannot solve the problems in forecasting the imminence of earthquake.

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